Bioremediation 4.0: What Procaryotic Microbes Can Really Accomplish and the Roll Quorum Sensing and Signaling (QSS) Plays

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Purpose: Bioremediation 4.0 recognizes the historic importance of planktonic bacteria then reaches beyond by adapting biostimulation strategies that prioritize supporting the ecosystem where indigenous microbial populations reside, not individual planktonic bacteria identified to support specific tasks. This new strategy is designed to support growth of microbial densities such that autoinducing signals reach threshold levels to allow intra- and inter-specie communication and the collective abandonment of a planktonic life for a more productive, collective world, as sessile microbes in a biofilm.

Process: As densities grow so does the collective secretion of biosurfactant-like-compounds to allow expedited solubilization of residual mass contaminants (sorbed, stringer, ganglia) and peptides, polysaccharides used to develope 'biofilms'. Within biofilms consortia of bacteria harmoniously realize rates of performance and sustainability beyond planktonic microbes of the same population. For 4.5 billion years procaryotic bacteria, under anaerobic conditions, have collectively communicated and built protective structures that allow enhanced electron transmissivity, expedited horizontal gene transfer; creates nutrient sinks and through endogenous decay decades of sustainable energy utilization. Within a biofilm individuals assume different roles, express genetic material differently, and work collectively to maximize performance. Genetic information is shared 10-100x that in bulk water. Water itself moves >10x faster in biofilm. Biofilm predominates biological life and operates within every ecosystem on the Earth. We as environmental specialists must stop believing our systems operate different from every other biological process on the planet.

The 'treatment zone' is not static but a vibrant ecosystem under stress due to the contamination present. Baseline bulk water analysis classically indicates populations are lacking; bioremediation won't succeed, but they are there. In response to stressed conditions microbes adopt a starvation strategy and become Ultramicrobactria (UMB). When the ecosystem is supportive again, UMB and their single strand of acclimated DNA re-emerge.

Summary: Procaryotic bacteria may be limited to a single strand of DNA and no nucleus but they aren't loners, solitary or, 'dumb'. Ask an infectious disease expert who for years recognize these beings are incredibly capable of achieving growth and behavioural patterns that defy modern medicine and mitigation technologies, realizing their value not as an individual but rather, as a consortium of intra-inter-specie microbes collectively maximizing the utilization of available protons/electrons.

Conclusion: A sea of change is occurring in the remediation industry, a change manly involving our catching up with existing awareness regarding QSS. We at TerraStryke strive to be pioneers in promoting Bioremediation 4.0 and the need to focus on the holistic ecosystem based on the concept of collective communication and information, electron, and resource sharing amongst the consortium of bacteria, not planktonic.

Goal: Spur environmental remediation/monitoring industries to move forward with that which the wastewater, medical, dental, and oil production industries have realized for decades: the individual planktonic microbe and what they do is not the concern; rather, it's what planktonic microbes accomplish when QSS is supported and they reside in a collectively constructed housing referred to as a 'biofilm'.

Kent Armstrong

A Graduate of California State University Long Beach, 'The Beach'; B.S. Terrestrial Ecology (Zoology), minor in Philosophy/Religious Studies, with Graduate Studies in Palynology (fossil pollen) and Paleoecology.

Numerous jobs as a butcher, human anatomy instructor, ravioli maker, warehouse and parts dispatch operator…real work began with the Los Angeles County Sanitation District as Plant Laboratory Chemist and then as a Treatment Plant Operator.

Over the next 35 years, Kent would work for and aid both government and corporate businesses with remediation strategies as a contractor, consultant, and general nice guy.

The culmination of these experiences afforded Kent the opportunity to participate in a wide variety of environmental investigation, remediation, and management projects combining numerous methods of physical, chemical, and biological strategies. . .

It also, 20+ years ago, introduced him to his patent partner, Richard Schaffner. Together, it led from a far-fetched concept to the formation, in 2008, of TerraStryke Products LLC.

Since then we have efforted the development of sustainable biostimulation additives designed to leverage existing site conditions and enhance indigenous microbial populations to realize safe, low-impact and cost-effective destruction of organic soil and groundwater contaminants, mimicking that which Mother Nature has done in every other ecosystem on the planet.